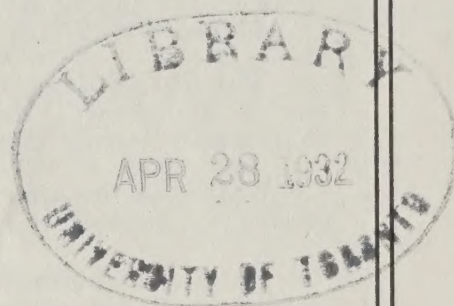


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The
Control of Grasshoppers in Canada
East of the Rocky Mountains

By Norman Criddle



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Summary of Grasshopper Control Measures

Grasshopper outbreaks usually follow, or occur during, abnormally dry weather.

Each female grasshopper lays at least 100 eggs; consequently, a single pair present on a square yard of land in autumn may be responsible for one hundred or more hoppers on the same area during the following spring. Farmers, therefore, are warned to check their grasshopper population in order to be prepared for impending danger. If eggs are present in sufficient numbers to threaten an outbreak efforts should be made to reduce them by (1) deep, well-turned ploughing, (2) shallow fall disking or cultivating.

The first of these methods will prevent a majority of the hoppers making their way to the surface; the second exposes many eggs to adverse atmospheric conditions which destroy them. See page 5.

Watch for the appearance of hoppers in May and early June. When they are present in destructive numbers employ the following control measures:—

(1) Scatter poisoned baits among them according to directions on page 7, making sure before doing so that the temperature is above 68° F. and not over 90° F. The success in applying poisoned bait depends upon the temperature. On no account should baits be spread on cold or cloudy days.

(2) Check the advance of the hoppers from adjacent areas by ploughing guard strips. Force the insects to the centres of stubble fields by ploughing inwardly and poison the central strips. See page 6.

(3) Scatter straw for the newly hatched hoppers to sleep in and burn this at night.

(4) Watch for the invasion of winter wheat or rye and poison the grasshoppers found attacking it.

Grasshoppers do not deposit eggs in clean summer-fallow or in newly ploughed land but may do so among winter wheat or rye. Their main egg beds will be in stubble fields, deserted farms, roadsides, and over-grazed pastures. All these places should be watched and measures taken to destroy the eggs when abundant.

In many localities, particularly on the prairies, grasshoppers fly long distances, consequently farms free from them in the spring may later become heavily infested. Watch should be kept for such invasions and steps taken to combat them when they occur.

When in doubt regarding the control of grasshoppers write to the nearest Entomological Laboratory, Provincial Department of Agriculture, or Agricultural College for advice. Officers at such stations are always pleased to be of assistance.

The Control of Grasshoppers in Canada East of the Rocky Mountains

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INTRODUCTION

The grasshoppers dealt with in this pamphlet are all natives of Canada. As a rule, they are not sufficiently numerous to cause appreciable harm to crops but about every eleven years they increase in parts of the Dominion to dangerous numbers. When this happens it becomes necessary to take measures to combat them.

The year 1931 was one of marked grasshopper increase throughout Canada and so menacing is the situation that in all localities where these insects have ever been known to have been injurious or where they were noted as unusually abundant during 1931, care should be taken to prepare to control the possible outbreak in the spring of 1932. In the three Prairie Provinces, particularly, following the injurious and widely distributed local outbreaks of 1931, there is every prospect of severe losses from this insect in many localities during 1932.

To those who have had experience in grasshopper control work an assurance of the effectiveness of the use of the poisoned bait will be unnecessary. To others who have not as yet attempted to protect their crops from grasshopper damage we can give an unqualified assurance of success if the recommendations suggested are followed with reasonable care. The early recognition of danger and the use of the poisoned bait at the time of day when the temperature is right is the key to effective control activities on the individual farm or in campaigns upon a large scale. If prompt and early application of the control measures is instituted by every farmer threatened with crop damage in 1932 a probable loss which is conservatively estimated at millions of dollars, taking the country as a whole, may be reduced to insignificance.

Below is presented a summary of what has been found to be the most effective and practical means of control of grasshoppers east of the Rocky mountains.

KINDS OF GRASSHOPPERS INVOLVED IN OUTBREAKS

Any kind of grasshopper may become obnoxious providing it is present in sufficient numbers, but as a rule those forms which do so are comparatively few and they usually comprise only four or five species, these being, the lesser migratory grasshopper, the red-legged grasshopper, the two-striped grasshopper, and the clear-winged or roadside grasshopper. Most of these grasshoppers have very similar habits and it will not, therefore, be necessary to treat them separately.

HABITS OF GRASSHOPPERS

All the different grasshoppers with which we are here concerned hatch from eggs deposited in the ground during the previous year. Their appearance in spring depends upon the weather, but under average conditions some of them can be expected to emerge early in May, while others will not do so until well into June. Warm weather hastens their emergence and development; cold weather retards them.

As the newly hatched grasshopper, or hopper as it is termed, makes its way to the surface, it undergoes what is known as the natal moult and leaves near

its exist hole a curled-up, white skin. Before this, it was a helpless object unable even to stand; immediately afterwards it presents all the appearance of a miniature, wingless grasshopper excepting that it is pale in colour and requires an hour or more to become fully coloured.

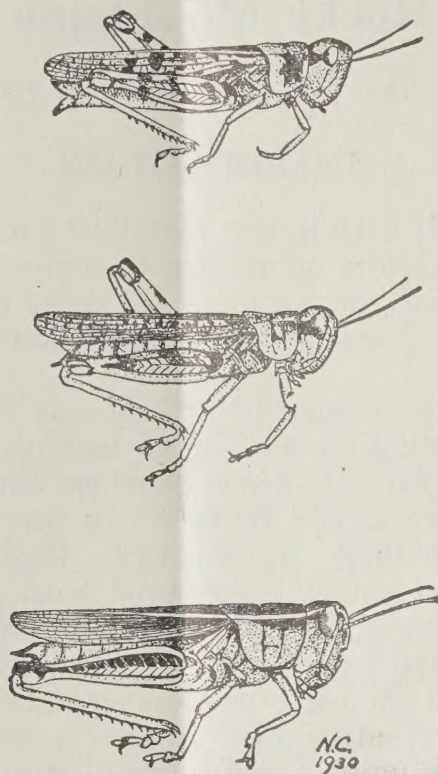


FIG. 1.—Adult grasshoppers. Upper figure, clear-winged grasshopper; middle figure, lesser migratory grasshopper; lower figure two-striped grasshopper. All natural size. (Author's illustration).

The hopper now seeks a sunny, sheltered, situation where it basks in the sun and undergoes that further developing process necessary to assume its place with its hungry companions. Feeding does not usually take place until the following day and to begin with the amount of food taken is small. Two activities now dominate the insect's life, namely, the act of feeding and that of sunning itself. In the morning, as the sun begins to warm the atmosphere, the hopper leaves the shelter which it has occupied overnight and joins its associates in some sunny spot where they all huddle together in a mass, governed in size by the numbers present in the vicinity. Here they remain until the temperature rises to about 65° F. in the shade, when they begin to scatter in search of food. The height of the feeding activity, however, is not reached until the temperature attains approximately 78° F.

With feeding comes growth and as the hopper's skin does not grow with the insect it becomes necessary to cast it off through a process known as moulting. This is done by the hopper hanging upside down attached by its legs to some support, and slowly wriggling out of its old coat. All our most injurious grasshoppers, on an average, moult five times in the course of their development.

Egg-laying.—While the process of egg-laying is similar in all our common grasshoppers, the situations chosen for the placing of the eggs are often quite different, and on this account it is necessary to know what kind of grasshopper we are dealing with. As a general rule it may be stated that the clear-winged grasshopper deposits its eggs in sod land, such as grassy roadsides, pastures and grass fields; rarely in clean stubble fields. All the other kinds, with which we are dealing, place their eggs in bare spots but especially in stubble land, the sides of ditches and old abandoned fields. Those of this last group rarely lay eggs

in clumps of grasses although they may be laid around them in openings free of vegetation. A field in which the grass is sparse or scattered as well as an overgrazed pasture may harbour many eggs. Recently ploughed land on the other hand is never utilized for egg-laying, nor is clean summer-fallow, but a corn field or potato patch may sometimes be rather heavily infested with eggs.

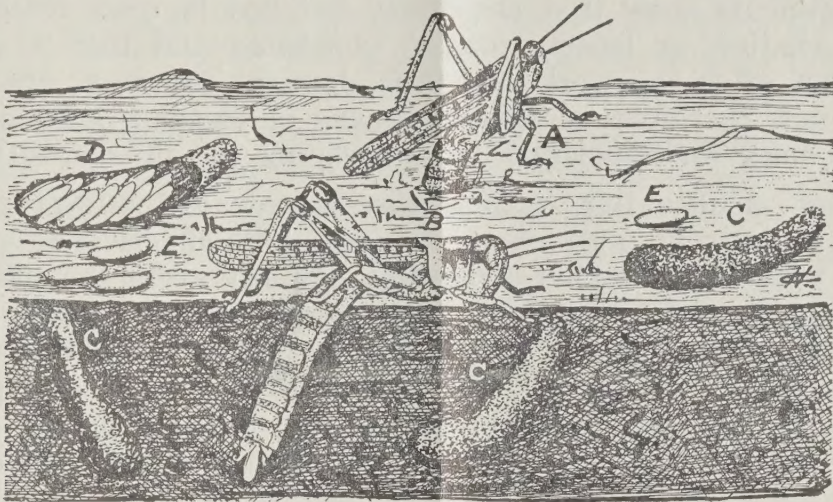


FIG. 2.—Lesser migratory grasshopper. (A) Drilling preparatory to egg-laying; (B) egg-laying; (C) egg-sacs; (D) egg-sac broken open to show eggs within; (E) individual eggs. All natural size. (Author's illustration).

LATE AUTUMN AND EARLY SPRING GRASSHOPPERS

There are several kinds of grasshoppers which hatch from eggs in late summer and which winter in a partly grown form. These may be found as soon as the thawing of the snow exposes the ground. They can be recognized at this time by their large size and by noting that the wing pads are turned upwards. Indeed, most of these grasshoppers will be flying before the really important ones have hatched. The commonest of these early species are the spring clear-winged grasshopper, the northern spring grasshopper, and the coral-legged grasshopper. These are the grasshoppers which usually give rise to the erroneous reports that eggs of the more injurious species are hatching in the autumn, or that they have done so abnormally early in the spring. The spring clear-winged grasshopper in particular has frequently been mistaken for the common clear-winged grasshopper which rarely begins to hatch before the middle of May. Occasionally these insects may do a certain amount of damage to fall wheat or rye but as a rule their activities are insignificant.

CONTROL

Grasshopper control to a certain extent depends upon the kind of grasshopper involved. This in particular relates to egg destruction and early hopper invasions from adjacent areas. If the insect concerned is the clear-winged grasshopper then, to begin with, only the nearby grass lands need be watched and attended to, but if it be the lesser migratory or the two-striped grasshopper then particular care must be given to the stubble fields, deserted farms, and to a lesser degree the grasslands as well. One of the first considerations, therefore, in early grasshopper control is to recognize the kind of grasshopper involved. While the methods employed in destroying these insects depend somewhat upon the species present and the conditions under which the outbreak is taking place, they may in a broad sense be outlined as follows:—

EGG CONTROL

Ploughing.—Land known to be infested with grasshopper eggs should be ploughed to a depth of not less than six inches and the furrow turned so that it

falls flat. If this advice is followed a large percentage of the hatching hoppers will fail to make their way to the surface, but if the furrow is merely turned on edge then a large number will escape. In any case it is advisable to harrow the land after ploughing and, if the work is done in the spring, the ploughing should be packed.

Our experiments show that the newly hatched hoppers readily make their way through shallow or loosely packed ploughing and that a certain number will do so even after the work has been done in the most approved fashion. Ploughing is not, therefore, a definite means of clearing land of grasshoppers but it can be made an important aid to keeping the insects within bounds.

Cultivating.—Cultivating with a disc-harrow or cultivator is sometimes very effective in destroying grasshopper eggs but its effectiveness depends a good deal upon the prevailing weather conditions. In any event the cultivation should be done as early as possible in the autumn, or as soon as a majority of the eggs have been laid. This, on an average, will be about the middle of September. The idea is to expose the eggs to the vicissitudes of weather, especially to the sun, which dries them up. Spring cultivation is of little or no value. In cultivating it should be remembered that grasshopper eggs at their lowest depth in the soil are not more than an inch below the surface and that shallow cultivation is all that is required to expose them.

PRECAUTIONS TO BE TAKEN

A knowledge that grasshoppers are likely to be troublesome in certain areas enables us to provide for their reception or take measures to counteract their threatened activities. Among such precautionary measures the following may be found useful:—

Guard strips.—When a field of grain exists next to one known to be infested by young hoppers it will often be an advantage to plough a strip between the two to act as a barrier. This will retard the advance of the insects for several days, and if a deep, wide furrow is ploughed on the side from which the insects are advancing, this will temporarily entrap them and provide a convenient situation for killing them with poisoned bait.

Another method that can be recommended is to plough infested fields from the outside and thus gradually force the hoppers to the centre, or to central strips. Then, when the remaining unploughed areas are about 20 feet wide, poisoned bait should be scattered over them. It is advisable to avoid making these strips too narrow during the heat of the day but rather to do the final ploughing in cool weather or late in the afternoon. Moreover, the strips should be poisoned over immediately the hoppers show marked activities, that is when the temperature reaches about 68° F. in the shade. A delay may result in their leaving the unploughed strips and invading the nearby fields.

Time of sowing.—Early sown grain, due to its more advanced growth, is better able to withstand grasshopper attack than is late sown grain.

Spring ploughing.—Care should be taken to avoid sowing crops on spring ploughing known to be impregnated with grasshopper eggs. There are no crops immune from these insects and when they hatch all over a field the difficulty and cost of saving the crop is very great.

Burning.—Young hoppers require some sort of shelter in which to pass the night. Rough ploughing will provide this, as will also weeds. If there are no shelters in the grain field the insects will retire to the protective margins of the field for the night where they collect among the weeds or grass but if similar shelters are available in the fields then there will be no check to their advance. It is largely due to the necessity for shelter, to begin with, that the advance

into a field is so uneven. The habit of seeking shelter suggests the spreading of small quantities of straw near the places where the insects are feeding, among which they will gather towards evening and remain until next morning. The straw should be burned at night, preferably when a breeze is blowing. Road-sides can, also, be burned over with a profit when the hoppers first emerge and before they invade the adjacent grain fields.

Infestation of autumn sown crops.—Winter wheat and rye are apt to be severely attacked by adult grasshoppers and it becomes necessary, therefore, to watch for the invasions of these crops and to destroy the insects when this occurs. This can be accomplished by the application of poisoned baits. Another danger to such crops is incurred when the grasshoppers lay eggs among them from which hoppers emerge and attack them the following spring. On this account the poisoning of adults in autumn becomes additionally important.

DESTRUCTION OF THE HOPPERS AND ADULTS

Poisoned baits.—Of all the methods employed in controlling grasshoppers, poisoned baits in their effectiveness stand out alone. A number of these have been devised and several are recommended in different parts of North America, but in recent years we have discovered that the time of applying baits is of more importance than are the exact ingredients with which they are made and that success or failure in their application is very largely a matter of temperature.

A poisoned bait which was used extensively in Manitoba during the 1919-23 outbreaks of grasshoppers is prepared as follows:—

Bran	50 pounds
Sawdust	50 “
White arsenic or Paris green	5 “
Salt	2 “
Water, about	10 gallons

The first three ingredients are mixed together and the salt and water afterwards added. All are then stirred until thoroughly mixed. The bait is then ready for use. It should be sufficiently dry to crumble in the hands, and on this account the amount of water used depends on the moistness of the sawdust. This bait can be made somewhat more attractive by the addition of one quart of cheap molasses or by adding five ounces of amyl acetate. Either one may be added, not both. These extras are of most value under adverse weather conditions such as an overcast sky or a low temperature when some extra attraction is needed to induce the grasshoppers to eat. Salt, while a distinct appetizer and more or less an attractant over most of the country, loses its value when the water used for mixing baits is salty or alkaline and under these circumstances one of the two ingredients mentioned above might be used to advantage instead. Water has a distinct attractiveness to the insects especially under hot, dry weather conditions, and on this account the importance of applying the bait when it is moist cannot be too strongly emphasized. It should be recognized that grasshoppers drink as well as eat and that they do not relish dry food. We recommend white arsenic for extensive campaigns because of its cheapness and accessibility in large quantities.

Sawdust is not eaten as readily by the grasshoppers as is bran but this disadvantage is offset by its cheapness and its value as an aid in mixing. It also helps to insure an even spread and reduces the tendency to waste the bran by scattering it too thickly. When sawdust is not available bran can be used alone or the former may be used in smaller proportions.

A bait which gained considerable notoriety in Manitoba during the grasshopper campaign of 1900-03 and has since been used with success in other parts

of the world, is known as the Criddle mixture. This bait is prepared in the following manner:—

Horse droppings.	100 pounds
White arsenic or Paris green.	5 “
Salt	2 “
Water to moisten.	

As in other baits the salt and water are added after the first two ingredients have been thoroughly mixed. This bait is not practical at central mixing stations but it has an important place for individual farmers who reside some distance from such stations. Its chief advantage lies in its cheapness and it is in other respects, as well, a thoroughly efficient bait.

As we have stated above, the success of poisoned bait applications depends to a marked degree upon weather conditions, but especially upon temperature. **The day should be bright but above all else the temperature when the bait is put out should not be less than 68° F. in the shade with indications that it will rise still higher within the next hour. The temperature at which grasshoppers feed most freely is between 75° F. and 85° F.; they stop eating when it rises above 95° F. or when it falls below 65° F. The secret of success in poisoning grasshoppers is, therefore, to spread the bait when the appetite of the insects is keenest; this, as intimated above, is when the temperature reaches approximately 75° F. in the shade.** By applying the bait at this time we can be sure of its being fresh and moist, in which condition it is most appreciated by the grasshoppers, the result being a maximum kill for the expense and labour involved.

Care should be exercised in spreading poisoned bait so as to scatter it finely; 25 pounds are sufficient to cover approximately four acres. It should be placed amongst the grasshoppers in order that they may begin to eat it as soon as it reaches the ground. It is, also, necessary in spreading poisoned bait to use some sort of vehicle to carry it in order that one may get over the ground quickly. Anything from a horse and a rig to a motor car may be utilized for this purpose, and the bait can be spread broadcast either by hand, with the aid of some convenient article such as a trowel, or even by mechanical spreaders. The last named as yet, however, have not proved very successful. The main necessity in spreading bait is to scatter it finely and place it where it can be immediately eaten by the grasshoppers.

Grasshoppers are more easily reached before they attain the winged stage but they will eat poisoned bait at any stage of their development, and in reality they are probably more readily poisoned when large than when small due to the proportionally greater amount of poisoned bait eaten.

The danger of leaving mixing utensils where live stock can reach them should be carefully guarded against. This also applies to bags in which bait is transported. Poisoning of live stock is also possible when poisoned bait is put out in lumps instead of being spread finely. If cattle are well supplied with salt they will be less apt to be attracted to bait in which salt is present. We would, also, emphasize the danger, in mixing baits, of getting the poison dust into the mouth or nose. This can be avoided by tying a cloth over these organs or by wearing a mask.

The use of hopperdozers and other mechanical contrivances have all been superseded by the more practical and efficient poisoned baits; the same can be said of poison gases, oil sprays and burners. There is always a tendency during grasshopper epidemics to resort to some supposedly new and untried method of control, or for some inventive member of the community to demonstrate his mechanical ingenuity. Judging from past experience, however, such innovations are rarely, if ever, of any practical value, and it seems wisest to confine our energies to the methods which have proved to be efficient and leave to experts the problem of attempting to devise something better.